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Published in:
UK Luminescence and ESR Meeting 2013

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

A luminescence imaging system for routine single grain OSL dating

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In optically stimulated luminescence (OSL) dating and other retrospective dosimetry studies there is a considerable demand for the ability to measure luminescence from dosimeters in the size range 50-500 μm diameter, either as loose grains or as part of a matrix. In the past this has been achieved by stimulating each grain sequentially, and collecting all the luminescence using a PM tube. The alternative approach discussed here is to stimulate all the grains simultaneously and image the resulting luminescence. The potential of such OSL imaging systems has been investigated before although none have managed to break through into routine application.

Here we describe a high sensitivity imaging attachment to the Risø TL/OSL platform. Images are captured by a Peltier cooled (-80^{o}C) Evolve EMCCD camera (Photometrics); this uses frame transfer and electron multiplier gain (up to 1000 times). The optics are based on fused silica lenses with anti-reflection coatings, providing high UV-VIS transparency, large numerical aperture (~0.35) and ~0.8 magnification. Because the focal plane is dependent on the emission wavelength, the optics are mounted on a sequence-controlled motorized focusing unit. Alternatively, near-UV achromatic optics are available, but at the cost of a lower UV sensitivity. Standard 9.7 mm diameter single grain discs (each containing 100 grain holes) are used to present the samples to the camera. Images collected during a single TL/OSL measurement are processed automatically to produce a TL glow curve or OSL decay curve summed over each grain location. Each disc is spatially located after each TL or OSL measurement to compensate for rotation and/or translation from one measurement to another.

After a description of the instrument, we characterize its performance by discussing stability, sensitivity and background count rate. Finally we present a typical single grain dose distribution.

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